Name Key

# Periodicity Unit Practice Test

1. When ignited, a uranium compound burns with a green flame. The wavelength of the light given off by this flame is longer than that of

   a) red light. b) infrared light. c) radio waves.
   d) ultraviolet light. e) none of these

2. Which one of the following types of radiation has the shortest wavelength, the greatest energy, and the highest frequency?

   a) ultraviolet radiation b) infrared radiation c) visible red light
   d) visible blue light e) radio waves

3. Which of the following frequencies corresponds to light with the longest wavelength?

   a) $3.00 \times 10^{13}\ s^{-1}$ b) $4.12 \times 10^{5}\ s^{-1}$ c) $8.50 \times 10^{20}\ s^{-1}$
   d) $9.12 \times 10^{12}\ s^{-1}$ e) $3.20 \times 10^{9}\ s^{-1}$

4. In an investigation of the electronic absorption spectrum of a particular element, it is found that a photon having $\lambda = 500$ nm provides just enough energy to promote an electron from the second quantum level to the third. From this information, we can deduce

   a) the energy of the $n = 2$ level.
   b) the energy of the $n = 3$ level.
   c) the sum of the energies of $n = 2$ and $n = 3$.
   d) the difference in energies between $n = 2$ and $n = 3$.
   e) all of these

5. When a hydrogen electron makes a transition from $n = 3$ to $n = 1$, which of the following statements is *true*?

   I. A photon is emitted.
   II. A photon is absorbed.
   III. The electron loses energy.
   IV. The electron gains energy.
   V. The electron cannot make this transition.

   a) I, IV b) I, III c) II, III
   d) II, IV e) V

6. What is the wavelength of a photon of red light (in nm) whose frequency is $4.60 \times 10^{14}$ Hz?

   a) 652 nm b) $153 \times 10^{6}$ nm c) 153 nm
   d) 460. Nm e) none of these

$3 \times 10^{8} = (4.60 \times 10^{14})\lambda$

$\lambda = 6.52 \times 10^{-7}\ m$

7. When an electron in a 2p orbital of a lithium atom makes a transition to the 2s orbital, a photon of wavelength 670.8 nm is emitted. The energy difference between these 2p and 2s orbitals is

a) $2.961 \times 10^{-10}$ J
b) $2.961 \times 10^{-19}$ J
c) $3.380 \times 10^{18}$ J
d) $2.961 \times 10^{-17}$ J
e) none of these

$2.998 \times 10^{8} = f\,(670.8 \times 10^{-9})$

$f = 4.47 \times 10^{14}\ Hz$

$E = 6.626 \times 10^{-34}(4.47 \times 10^{14})$

$E = 2.96 \times 10^{-19}\ J$

8. What is the wavelength of light that is emitted when an excited electron in the hydrogen atom falls from n=5 to n=2?

a) $5.12 \times 10^{-7}$ m
b) $4.34 \times 10^{-7}$ m
c) $6.50 \times 10^{-7}$ m
d) $5.82 \times 10^{-7}$ m
e) none of these

$E_5 = -2.178 \times 10^{-18}\left(\frac{1^2}{5^2}\right) = -8.712 \times 10^{-20}\ J$

$E_2 = -2.178 \times 10^{-18}\left(\frac{1^2}{2^2}\right) = +5.445 \times 10^{-19}\ J$

$4.574 \times 10^{-19}\ J$

$4.574 \times 10^{-19} = 6.626 \times 10^{-34} f$

$f = 6.903 \times 10^{14}\ Hz$

$3 \times 10^{8} = 6.903 \times 10^{14} \lambda$

$\lambda = 4.35 \times 10^{-7}\ m$

9. The energy of the light emitted when a hydrogen electron goes from $n = 2$ to $n = 1$ is what fraction of its ground-state ionization energy?

a) 3/4 b) 1/2 c) 1/4
d) 1/8 e) 1/9

10. Consider an atom traveling at 1% of the speed of light. The deBroglie wavelength is found to be $3.31 \times 10^{-15}$ m. Which element is this?

a) He
b) Ca
c) F
d) Be
e) P

$3.31 \times 10^{-15} = \dfrac{6.626 \times 10^{-34}}{m\,(3 \times 10^{7})}$

$m = \dfrac{6.67 \times 10^{-27}\ kg}{1\ atom} \Big| \dfrac{6.02 \times 10^{23}\ atoms}{1\ mol} \Big| \dfrac{1000\ g}{1\ kg}$

$= 4.02\ g/mol$

11. Which of the following is an incorrect designation for an atomic sublevel?

a) 1s b) 3d c) 1p
d) 4f e) 6s

12. The electron configuration for the barium atom is:

a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
b) [Xe] $6s^2$
c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
e) none of these

13. All halogens have the following number of valence electrons:

a) 2 b) 3 c) 5 d) 7 e) none of these

14. How many electrons can be contained in all of the orbitals within the 4th energy level?

a) 2 b) 8 c) 10 d) 18 e) 32 $2n^2 = 2(4)^2 = 32$

15. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$ is the correct electron configuration for which of the following atoms?

a) Ca b) Ti c) Ge d) Zr e) none of these

16. Write the complete electron configuration for Ag.

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^9$
or $5s^1 4d^{10}$

17. The electron configuration of $Cr^{3+}$ is

a) $[Ar]4s^2 3d^1$ b) $[Ar]4s^1 3d^2$ c) $[Ar]3d^3$ – loses valence $e^-$ first
d) $[Ar]4s^2 3d^4$ e) none of these

18. Write the complete electron configuration for the ion, $S^{2-}$

$1s^2 2s^2 2p^6 3s^2 3p^6$

19. An element has the electron configuration $[Kr]4d^{10}5s^2 5p^2$. The element is a(n)

a) nonmetal. b) transition element. c) other metal.
d) lanthanide. e) actinide.

20. In which of these groups do all the elements have the same number of valence electrons?

a) P, S, Cl
b) Ag, Cd, Ar
c) Na, Ca, Ba
d) P, As, Se
e) none

21. How many d orbitals have $n = 3$?

a) 2 b) 5 c) 10 d) 7 e) 18

22. If $n = 2$, how many orbitals are possible? $2s^2 + 2p^6 = 8e^- = 4$ orbitals

a) 3 (b) 4 c) 2 (d) 8 e) 6

oops

23. Ti has ____ electrons in its d orbitals.

a) 1 (b) 2 c) 3 d) 4 e) none of these

24. Which of the following atoms or ions has 3 unpaired electrons?

(a) N b) O - has 2 c) Al - has 1 d) $S^{2-}$ has zero e) $Zn^{2+}$ has zero

25. Of the following elements, which needs three electrons to complete its valence shell?

a) Ba b) Ca c) Si (d) P e) Cl

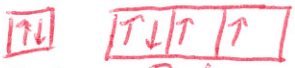
26–27. Given the following elements
a. write the electron configuration (you may use the noble gas notation)
b. draw the orbital model for the last period of the element
c. state the number of unpaired electrons in its ground state:

26. Fe

[Ar] $4s^2$ $3d^6$ 

4 unpaired e⁻s

27. Sulfur

[Ne] $3s^2$ $3p^4$ 

2 unpaired e⁻s

28. Order the elements S, Cl, and F in terms of increasing atomic radii.

a) S, Cl, F
b) Cl, F, S
c) F, S, Cl
(d) F, Cl, S
e) S, F, Cl

29. Order the elements Ga, As, and N in terms of increasing first ionization energy.

(a) Ga, As, N
b) As, N, Ga
c) N, Ga, As
d) N, As, Ga
e) Ga, N, As

30. Choose the element below with the highest ionization energy.

a) Na b) Mg c) Al d) P (e) S

31. Ionization energy increases with an increasing number of electrons. ( True / (False) )

- Not when it starts a new energy level.

32. Which statements about hydrogen are true?

I. H has a lower ionization energy than He.
II. $H^-$ is smaller than H.
III. $H^+$ is smaller than H. – if H loses an $e^-$, all that is left is a proton
IV. H is an alkali metal.
V. H does not have a second ionization energy. – only has 1 $e^-$

a) I, V b) II, IV c) I, III, V
d) II, IV, V e) I, III, IV, V

33. Element X has the following ionization energies with the same unknown unit:

$1^{st}$: 245 $2^{nd}$: 498 $3^{rd}$: 756 $4^{th}$: 4290 big jump after 3 $e^-$ lost

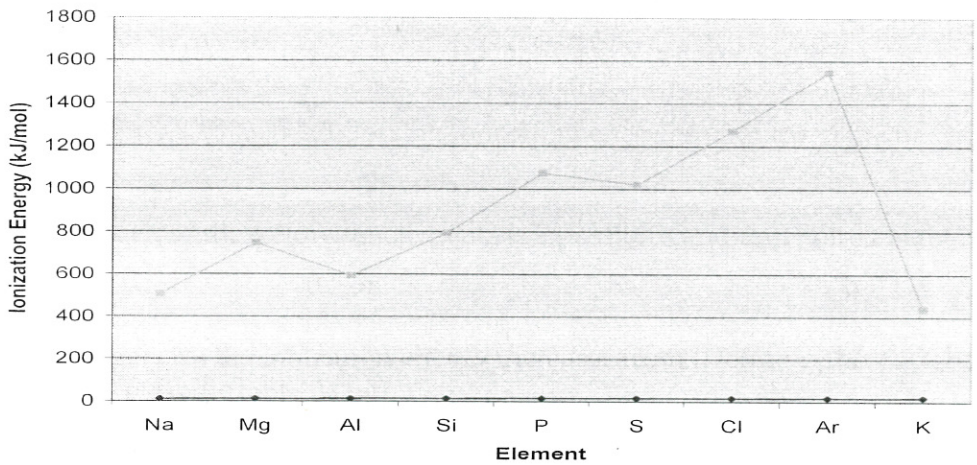
Which of the following elements is a possible candidate for element X?

a. Na b. Sr c. Ba d. Ga has 3 valence $e^-$s e. Pb

34. In general the ionization energy increases from ( left to right / right to left ) in a period of the periodic table. Why?

More protons in the nucleus have a stronger pull on electrons, so it takes more energy to remove an electron

**Consider the graph below to answer the next question:**




35. Explain why the ionization energy suddenly drops in the case of potassium.

Potassium has started a new energy level, so it is much larger. Because that 1 valence electron is far from the nucleus, it is easy to remove.

36. Write the reaction for

a. The first ionization of strontium

$Sr \rightarrow Sr^{+} + e^{-}$

b. The third ionization of boron

$B^{2+} \rightarrow B^{3+} + e^{-}$

37. Which statements are true about electron affinity?

I. Electron affinity generally increases moving to the right on the periodic table. T
II. Electron affinity generally increases moving down the periodic table. F
III. Electron affinity is expressed as the energy released when an electron is gained. T
IV. Electron affinity always has a negative enthalpy change.
V. Electron affinity is the exact opposite of ionization energy.

a) I, V b) II, IV c) I, III, V
d) II, IV, V e) I, III, IV, V f) I, III

38. Elements #27-30 have the following electron affinities (in kJ/mol):

Co (-64) Ni (-112) Cu (-119) Zn (>0)

Why does the electron affinity increase, and then suddenly drop in the case of zinc?

Zn has a full d-sublevel. Gaining an electron would mean starting a new p-sublevel.